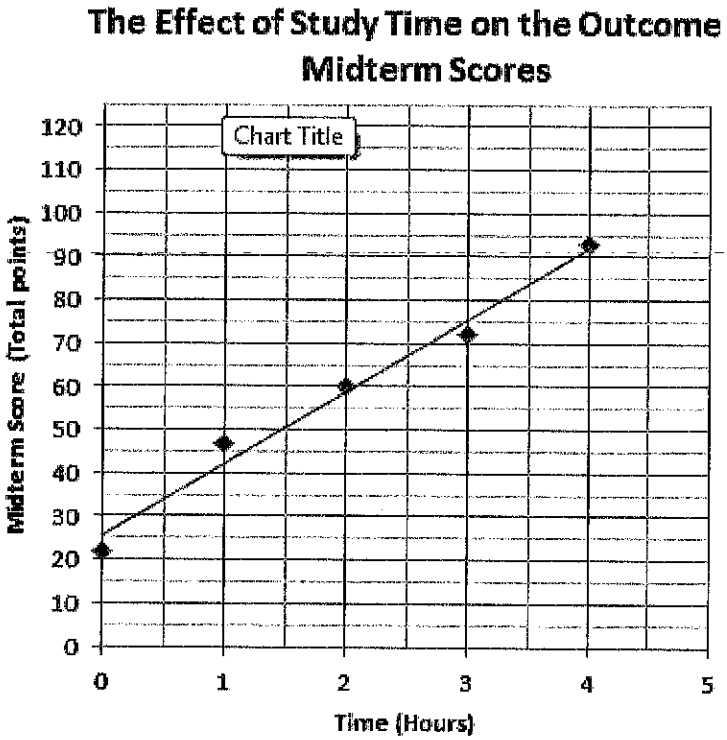
Chem 311 – Midterm Review Practice Problems

Chapter 1: Introduction to Chemistry

Examine the following graph and answer the questions that follow



1. What is the dependent variable? _____

2. What is the relationship between study time and midterm scores? _____

3. Based on the trend line, what is the average increase in point value per hour?

4. What score could one expect to receive after studying for 2.5 hours? _____

5. Using extrapolation, determine the amount of time one would have to study to get a score of 100 on the midterm? _____

Chapter 2: Matter and change

1. Using one of the following terms: *element*, *compound*, *solution*, or *heterogeneous mixture*, classify the following materials.

   a. methane gas (CH_4) *Answer*: _____

   b. sugar dissolved in water *Answer*: _____

   c. Air *Answer*: _____

   d. Granite *Answer*: _____

   e. Brass *Answer*: _____

   f. Zirconium *Answer*: _____

3. Perform the following calculations and round your answers to the correct number of significant figures.

$(6.8 \times 10^{23})(2 \times 10^{-8})$ $1.05 \times 10^{4} + 9.8 \times 10^{3}$ $4.32 \times 10^{-4} / 6.5 \times 10^{-12}$

4. Perform the following conversions using the factor label method. Report your answer in proper **scientific notation with the correct number of sig figs.**

1.0 kg = 2.2 lb	*1.0 L = 34.0 oz*	*3 ft = 1 yd*	*1.6km = 1 mi*
1.0 in = 2.54 cm	*1.0 m = 1.13 yd*	*5280 ft = 1 mi*	*12 in = 1 ft*

a. How many yards are equal to 0.680 km?

Answer: _____

b. How many picoliters are there in 0.00018oz

Answer: _____

c. Light travels at 3.00×10^{8} m/s; what speed is that in mi/hr ?

Answer: _____

5. What is the relationship between the following variables?

Density and Mass _____ Mass and Volume _____ Density and Volume_____

6. Calculate the volume of a gold brick in Liters with the dimensions of 3.5 cm x 5.0 cm x 23.2 cm. Gold has a density of 19.3g/ml.

7. What is the mass of chlorine gas that would fill a 250 ml jar at 25°C? The density of Cl_2 at 25°C is 2.994 kg/m^3.

2. Determine whether the following properties are physical or chemical, and intensive or extensive by placing an "X" in the appropriate boxes.

Property	Physical	Chemical	Intensive	Extensive
Density				
Conductivity				
Mass				
Color				

3. Determine whether the following processes represent physical or chemical changes by placing an "X" in the appropriate box.

Process	Physical	Chemical
Filtration		
Decomposition		
Change in color		
Crystallization		

4. Determine whether the processes are endothermic or exothermic by placing an "X" in the appropriate box.

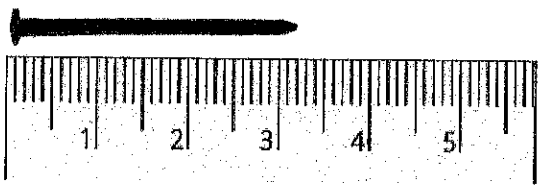
Process	Endothermic	Exothermic
Freezing of Bromine		
An explosion		
Boiling of water		

5. Record the technique and property which would be used to separate the following mixtures

Mixture	Technique	Property
A solution of salt water (to yield salt crystals)		
A solution of alcohol and water		
Spaghetti in a pot of water		

Chapter 3: Scientific Measurement

1. How long is this nail? _____ (each line represents 0.1 cm)



2. How many significant digits are there in the following measurements?

10.0600 cm ____ b. 0.00068050 pg ____ c. 653000 m ____ d. 1.860×10^{15} L ____

8. A beaker is filled to the 250.0 mL line and then poured into a graduated cylinder. The cylinder, being a more precise instrument, shows that the volume is 243.50 mL. What is the percent error in the measurement using the beaker? (assume that the value recorded for the cylinder is your accepted value).

Chapter 4: Atomic Structure

1. Complete the following table for the most common isotope

Atomic Number	*Mass Number*	*Number of Protons*	*Number of Neutrons*	*Number of Electrons*
8			8	
	14		7	
			21	20

2. Atomic Mass

The relative abundances of the isotopes of palladium are given below. Using this data calculate the average atomic mass of palladium. You will only be given credit if you show all your work. Follow all significant figure rules.

Pd-102	101.9056 amu	1.02 %
Pd-104	103.9040	11.14
Pd-105	104.9051	22.33
Pd-106	105.9035	27.33
Pd-107	107.9039	26.46
Pd-110	109.9052	11.72

Answer: _____

Chapter 25: Nuclear Chemistry

1. Write the following decay reactions:

a. Alpha decay of Pu-250

b. Beta decay of Ca-45

c. Electron capture by S-28

d. Positron emission by Sc-41

2. Solve the following half-life problems.

a. What is the half-life of Zr-110 if it takes 1.6 seconds for 120.0 g of the isotope to decay to 7.5 g?

Answer: _____

Chapter 5: Electrons in Atoms

1. Answer the following questions using the information given below. Be sure to report your answer in **scientific notation.** (7 pts)

$c = 3.00\times10^{8}$ m/s $h = 6.626\times10^{-34}$ Js $E = h\nu$ $c = \lambda\nu$ $1\ m = 1\times10^{9}$ nm

a. What is the wavelength, in meters, of light with a frequency of 7.32×10^{19} Hz?

Answer: _____

b. What is the energy of a photon of light with a frequency of 2.98×10^{7} Hz?

Answer: _____

c. Which of the two waves above has greater energy? Support your answer using either math or a written explanation.

d. What is the relationship between:

E and ν _____ λ *and* ν _____ E and λ _____

2. Answer the following questions regarding electron structure of the following elements

ELEMENT	*Orbital Dot Diagram*	*Noble Gas Electron Configuration*
		[Ne] $3s^2 3p^3$
		
Ho	Too big to fit here	

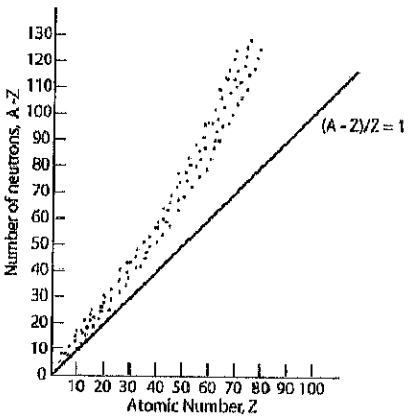
b. How long would it take an isotope to decay from 3.0g to 0.75g if its half-life 3.24×10^6 years?

Answer: _____

c. What amount of a 40.2g sample of I-130 would remain after 12 years if it's half-life is 18 months?

Answer: _____

3. Refer to the band of stability graph to answer the following questions:



a) Given the band of stability diagram, what type of decay would Zr-110 undergo?

b) Write the equation for the decay of Zr-110 given your answer in (b) and circle the daughter nucleus in the equation.

4. Write the following induced transmutation reactions:
   a. Iron-60 undergoes alpha bombardment and produces two neutrons in addition to its daughter nuclide.

   b. Potassium-46 undergoes beta bombardment and produces three neutrons, chlorine-43 and what other particle?

Chapter 6 and 7.1: The Periodic and Ionic and Metallic Bonding

1. Fill in the following table with the correct information.

Element	Chemical Family	Block	Lewis Dot Structure	Most common ion
Strontium				
Iodine				
Lead				
Chromium				
Berkelium				
Antimony				
Rubidium				
Sulfur				

Chapter 8: Covalent Bonding

1. Draw the structural formula for AsO_3^{3-} (arsenite ion)

   What is it's shape?

   Is it polar or non-polar?
   (if so, show the direction of polarity

2. Draw the structural formula for $C_2H_5O_2$ (ethanoic acid)

   Is it polar or non-polar?
   (if so, show the direction of polarity)

The Modern Periodic Table of the Elements

Average relative masses are 2001 values, rounded to two decimal places.

All average masses are to be treated as measured quantities, and subject to significant figure rules. Do not round them further when performing calculations.

Mercury
80
Hg
200.59
Electronegativity → 1.9

1	2		3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Hydrogen 1 **H** 1.01 2.1																		Helium 2 **He** 4.00 —
Lithium 3 **Li** 6.94 1.0	Beryllium 4 **Be** 9.01 1.5												Boron 5 **B** 10.81 2.0	Carbon 6 **C** 12.01 2.5	Nitrogen 7 **N** 14.01 3.0	Oxygen 8 **O** 16.00 3.5	Fluorine 9 **F** 19.00 4.0	Neon 10 **Ne** 20.18 —
Sodium 11 **Na** 22.99 0.9	Magnesium 12 **Mg** 24.31 1.2												Aluminium 13 **Al** 26.98 1.5	Silicon 14 **Si** 28.09 1.8	Phosphorus 15 **P** 30.97 2.1	Sulfur 16 **S** 32.07 2.5	Chlorine 17 **Cl** 35.45 3.0	Argon 18 **Ar** 39.95 —
Potassium 19 **K** 39.10 0.8	Calcium 20 **Ca** 40.08 1.0		Scandium 21 **Sc** 44.96 1.3	Titanium 22 **Ti** 47.88 1.5	Vanadium 23 **V** 50.94 1.6	Chromium 24 **Cr** 52.00 1.6	Manganese 25 **Mn** 54.94 1.5	Iron 26 **Fe** 55.85 1.8	Cobalt 27 **Co** 58.93 1.8	Nickel 28 **Ni** 58.69 1.8	Copper 29 **Cu** 63.55 1.9	Zinc 30 **Zn** 65.39 1.6	Gallium 31 **Ga** 69.72 1.6	Germanium 32 **Ge** 72.61 1.8	Arsenic 33 **As** 74.92 2.0	Selenium 34 **Se** 78.96 2.4	Bromine 35 **Br** 79.90 2.8	Krypton 36 **Kr** 83.80 3.0
Rubidium 37 **Rb** 85.47 0.8	Strontium 38 **Sr** 87.62 1.0		Yttrium 39 **Y** 88.91 1.2	Zirconium 40 **Zr** 91.22 1.4	Niobium 41 **Nb** 92.91 1.6	Molybdenum 42 **Mo** 95.94 1.8	Technetium 43 **Tc** (98) 1.9	Ruthenium 44 **Ru** 101.07 2.2	Rhodium 45 **Rh** 102.91 2.2	Palladium 46 **Pd** 106.42 2.2	Silver 47 **Ag** 107.87 1.9	Cadmium 48 **Cd** 112.41 1.7	Indium 49 **In** 114.82 1.7	Tin 50 **Sn** 118.71 1.8	Antimony 51 **Sb** 121.76 1.9	Tellurium 52 **Te** 127.60 2.1	Iodine 53 **I** 126.90 2.5	Xenon 54 **Xe** 131.29 2.6
Caesium 55 **Cs** 132.91 0.7	Barium 56 **Ba** 137.33 0.9	57-70 *	Lutetium 71 **Lu** 174.97 1.1	Hafnium 72 **Hf** 178.49 1.3	Tantalum 73 **Ta** 180.95 1.5	Tungsten 74 **W** 183.84 1.7	Rhenium 75 **Re** 186.21 1.9	Osmium 76 **Os** 190.23 2.2	Iridium 77 **Ir** 192.22 2.2	Platinum 78 **Pt** 195.08 2.2	Gold 79 **Au** 196.97 2.4	Mercury 80 **Hg** 200.59 1.9	Thallium 81 **Tl** 204.38 1.8	Lead 82 **Pb** 207.20 1.8	Bismuth 83 **Bi** 208.98 1.9	Polonium 84 **Po** (209) 2.0	Astatine 85 **At** (210) 2.2	Radon 86 **Rn** (222) 2.4
Francium 87 **Fr** (223) 0.7	Radium 88 **Ra** (226) 0.9	89-102 **	Lawrencium 103 **Lr** (262) —	Rutherfordium 104 **Rf** (261) —	Dubnium 105 **Db** (262) —	Seaborgium 106 **Sg** (263) —	Bohrium 107 **Bh** (262) —	Hassium 108 **Hs** (265) —	Meitnerium 109 **Mt** (266) —	Ununnilium 110 **Uun** (271) —	Unnilunium 111 **Uuu** (272) —	Unnilbium 112 **Uub** (277) —	Ununtrium 113 **Uut** (284) —	Ununquadium 114 **Uuq** (289) —	Ununpentium 115 **Uup** (288) —	Ununhexium 116 **Uuh** (291) —		Ununoctium 118 **Uuo** (294) —

Lanthanum 57 **La** 138.91 1.1	Cerium 58 **Ce** 140.12 1.1	Praseodymium 59 **Pr** 140.91 1.1	Neodymium 60 **Nd** 144.24 1.1	Promethium 61 **Pm** (145) 1.1	Samarium 62 **Sm** 150.36 1.2	Europium 63 **Eu** 151.97 1.1	Gadolinium 64 **Gd** 157.25 1.2	Terbium 65 **Tb** 158.93 1.1	Dysprosium 66 **Dy** 162.50 1.2	Holmium 67 **Ho** 164.93 1.2	Erbium 68 **Er** 167.26 1.2	Thulium 69 **Tm** 168.93 1.3	Ytterbium 70 **Yb** 173.04 1.1
Actinium 89 **Ac** (227) 1.1	Thorium 90 **Th** 232.04 1.3	Protactinium 91 **Pa** 231.04 1.5	Uranium 92 **U** 238.03 1.4	Neptunium 93 **Np** (237) 1.4	Plutonium 94 **Pu** (244) 1.3	Americium 95 **Am** (243) 1.3	Curium 96 **Cm** (247) 1.3	Berkelium 97 **Bk** (247) 1.3	Californium 98 **Cf** (251) 1.3	Einsteinium 99 **Es** (252) 1.3	Fermium 100 **Fm** (257) 1.3	Mendelevium 101 **Md** (258) 1.3	Nobelium 102 **No** (259) 1.3